Chapter 1. Introduction

This chapter provides a brief description of the City of Seattle's Phase 2 component of the Denny Way/Lake Union CSO Control Project and briefly describes King County's planned combined sewer overflow (CSO) control facilities in the Denny basin. The chapter gives the background information necessary to understand the history and context of the Denny Way/Lake Union project and describes the organization of this Facilities Plan report.

1.1. Project Description

Approximately one-third of the City of Seattle (City) is served by a combined sewer system rather than separate sanitary and storm sewers, and many other areas are partially combined from the sewer separation program done in the 1960s. Combined sewer overflows are discharges of sanitary sewage and stormwater that occur during periods of prolonged or heavy rainfall. When the volume of wastewater entering the combined sewers exceeds system capacity, the system is designed to overflow at several designated relief points. The largest of the overflow points operated by King County (County) occurs at the Denny Way regulator station along the shore of Elliott Bay in Myrtle Edwards Park. Figure 1-1 shows the location of the project area and the Denny Way regulator station. Computer modeling of the County wastewater system indicates that overflows occur there more than 50 times per year and result in an average of more than 405 million gallons (MG) of combined sewage being discharged to the bay annually. Because the CSO discharges may contain solids, bacteria, and other pollutants, CSOs constitute a potential threat to the health of human and aquatic communities who use the receiving waters.

The City of Seattle's Phase 1 project component of the Denny Way/Lake Union CSO Control Project was a project to upsize conveyance lines along the east and south sides of Lake Union. King County's CSO control facilities are intended to accept City of Seattle Lake Union overflows captured in Phase 1, to contain overflows into Lake Union from the County's Dexter regulator station, and to reduce the discharge of untreated overflows at the Denny Way regulator station. Phase 2 is a City of Seattle project to connect the Phase 1 improvements to the new County facilities.

1.2. Project Background

This section describes the Denny basin, recounts the planning history behind the Denny Way/Lake Union CSO Control Project, describes the manner in which the project has been phased, and details the evolutionary path the project has taken to its present configuration.

1.2.1. Denny Basin Characteristics

The single largest combined sewer overflow in the King County system occurs at the Denny Way regulator station, located in Myrtle Edwards Park along Seattle's waterfront. The regulator station actually contains two separate regulators, the Denny local regulator and the Denny/Lake Union regulator. The Denny local regulator directs flow from the Denny local area, and the Denny/Lake Union regulator directs flows that enter the regulator station from the Lake Union area via the Lake Union tunnel. Figure 1-2 shows the areas that drain to the Denny Way regulator station. The overflows from these two regulators, together with overflows from the Elliott Bay interceptor at the Denny Way regulator station, are collectively referred to as the "Denny Way CSOs."

The basins that drain to the Denny Way regulator station are large and urban. These basins are comprised mostly of residential and commercial properties with high proportions of impervious surfaces. The rooftops, parking lots, streets, highways, and other impervious areas shed rainfall directly into the combined sewer system that serves the area. These sewers ordinarily discharge to King County's Elliott Bay interceptor (which carries wastewater from downtown Seattle to the West Point Treatment Plant) at the Denny Way regulator system. A 60-inch-diameter pipe from the Lake Union tunnel flows into the regulator station, and Denny local basin flows enter the regulator station by means of a separate 42-inch-diameter pipeline. During wet weather, however, the Elliott Bay interceptor is frequently full and has no capacity left for Denny local basin and Denny/Lake Union wastewater. Also at times, the interceptor itself overflows at the regulator station as a result of a constriction further downstream at the Interbay pump station. In either case, overflows at the Denny regulator station result. During many of those same wet periods, the King County Dexter regulator station and several overflows owned by the City of Seattle discharge combined wastewater directly into Lake Union. The Dexter overflow amounts to 15 MG in an average year, and City overflows into Lake Union average 86 MG per year.

1.2.2. Planning History

King County's responsibility for water pollution control can be traced back to 1958, when a metropolitan municipal corporation, popularly known as "Metro," was formed to clean up the waters of Lake Washington and Puget Sound. Metro grew to become a wholesaler of wastewater conveyance and treatment services to cities and districts throughout King County. In 1994, Metro and King County were consolidated, and the County assumed control of Metro's assets and obligations.

Metro began planning specifically for CSO control with the release of its *1979 CSO Control Planning Report*. During the early 1980s, considerable public attention focused on Puget Sound water quality and pollution issues, particularly contamination in urban bays. In May of 1984, Metro issued the *Toxicant Pretreatment Planning Study Summary Report*, which described toxicant problems in Elliott Bay and other bays and raised concerns about CSO impacts on sediment quality at discharge sites. That same year, the Washington State Department of Ecology (Ecology) introduced legislation (RCW 90.48.480) requiring all municipalities with CSOs to develop plans for "the greatest reasonable reduction (of CSOs) at the earliest possible date." Then, in January 1987, Ecology published a new regulation on CSO control (WAC 173-245-020(22)) defining the

"greatest reasonable reduction" of CSOs as "control of each CSO such that an average of one untreated discharge may occur per year." The regulation further required that, by 1988, each community must submit a CSO-reduction plan specifying the means of complying with the new CSO control mandate. Recognizing that reducing CSO discharges to one untreated discharge per year at Denny Way and other locations would take time, Metro worked with Ecology to develop an interim goal of a 75 percent CSO volume reduction system-wide (including 50 percent volume reduction at Denny Way) by the end of the year 2005. Metro's *1988 Combined Sewer Overflow Control Plan* (the *1988 Plan*) listed projects that would achieve Metro's interim volume reduction goal. The *1988 Plan* also pledged a continuing effort to achieve the long-term goal of one untreated discharge per outfall per year.

Recently, Ecology has agreed to waive the 75 percent volume reduction requirement imposed in 1988 in favor of an approach to scheduling CSO control projects based on environmental and public health benefits. Ecology's agreement to waive the 75 percent volume reduction requirement was based, in part, on its recognition of King County's efforts to fully control Denny Way overflows by 2006.

The same Ecology CSO-control mandate that applies to the County applies to the City of Seattle. However, unilateral action by the City to solve its Lake Union CSO problem might simply add to the County's problem. For example, City improvements that capture wastewater overflowing into Lake Union and deliver it to the Lake Union tunnel for transport to the Denny Way regulator station might increase County overflows by an amount equal to the reduction of City overflows. In 1992, the City (recognizing the hydraulic link between the two systems) proposed working together with Metro to find a joint, basin-wide solution to the overflow problems. The result is the Denny Way/Lake Union CSO Control Project.

1.2.3. Project Evolution

The *1988 Plan* called for a partial separation project to reduce overflows by 50 percent of baseline at the Denny Way regulator station. In 1992, Metro and Brown and Caldwell conducted a feasibility study to take a fresh look at CSO control at Denny. The *1992 Feasibility Study* concluded that storage and CSO treatment might be a more promising and cost-effective approach to overflow reduction. The project team working on the *Denny Regulator Accelerated CSO Control Program Report (1995 Denny Report)* reexamined control options including partial separation, storage, on-site CSO treatment facilities, and conveyance to existing facilities for treatment as a way to achieve control of overflows. The *1995 Denny Report* team evaluated various combinations of these approaches with the intent of arriving at a preferred CSO control project for the Denny basin.

The *1995 Denny Report* team held a workshop to brainstorm possible CSO control solutions for the Denny basin and then to screen those solutions to arrive at a much smaller number of options for further study. The team developed four basic groups of control options, each group emphasizing a different approach--a separation group that included three separation alternatives, a storage group comprised of seven storage options, a conveyance-to-treatment group with seven conveyance options, and an on-site treatment group containing four on-site treatment options. Twenty-one options within the

four groups were selected for further study and estimation of costs. The workshop participants identified one additional option, involving storage and/or treatment in the vicinity of the Interbay pump station, for further study as well.

In the weeks following the brainstorming workshop, the Denny team prepared planning-level cost estimates for each of the alternatives based on costs for general components, quantity take-offs, and experience on similar projects. The team reviewed the workshop evaluations and refined the options further in an attempt to increase component efficiency or reduce costs. By June 1994, the team had rejected the Interbay option, and by July, the partial separation options had been ruled out because of their higher costs. King County selected a preferred alternative for controlling Denny basin CSOs in early August.

The alternative selected in August 1994 as the preferred alternative for controlling overflows at the Denny Way regulator station was described in the *1995 CSO Update* and the *1995 Denny Report*. At that time, the preferred project consisted of the following components:

- 6,800 feet of 18-foot finished inside diameter storage tunnel, located under Mercer Street, from south Lake Union to the a site on Elliott Avenue West in the Mercer Street right-of-way. The tunnel would have provided 12.94 million gallons of CSO storage.
- Piping and regulator construction to connect the east end of the new tunnel with the existing Lake Union tunnel to accept flows from the City system.
- A 2.5-MG concrete storage tank located on the west side of Elliott Avenue West, on the site once occupied by the Blackstock Lumber Company.
- A 150-foot-long, 96-inch-diameter extension to the existing Denny CSO outfall.
- A 1,600-foot-long, 60-inch-diameter outfall for discharge of flows in excess of the storage capacity.
- Two 70 million gallon per day (mgd) pump stations, one to pump overflows into the tunnel and/or storage tank and one to pump effluent out through the outfall when tidal conditions require pumping.

That 1994 preferred alternative, which would have provided 15.44 MG of storage, was intended to store excess flows in the tunnel and then the storage tank until capacity became available in the Elliott Bay interceptor, at which time the stored wastewater would be allowed to drain back into the interceptor for conveyance to the West Point Treatment Plant. Excess water would be discharged through the new outfall at the Elliott West facility if all system storage components were full and the storm continued, but only after first passing through the Elliott West tank, where floatable material would be removed. If the stormwater volume became so great that wastewater flows exceeded capacity of the Elliott West outfall, the remaining wastewater would be allowed to escape from the system at the existing Denny Way regulator station through the existing CSO outfall. The existing outfall would be extended, however, to move the CSO discharge away from the shoreline. Modeling indicated that the facilities would be able to

accept the Dexter and City overflows to Lake Union and still reduce the annual CSO discharge volume at Denny to less than 50 percent of the 405 MG per year baseline overflow volume.

Maximizing overall flexibility of the County's wastewater system was an important consideration in late 1994 and early 1995. The 18-foot diameter tunnel was selected because it would integrate with all of the wastewater alternatives then being considered by King County's Regional Wastewater Services Plan (RWSP) team. The 18-foot tunnel could also be operated to maximize storage or to equalize flows (and thus improve effluent quality). Furthermore, a preferred alternative with a tunnel as large as 18 feet in diameter might offer opportunities to transfer additional CSO flows to Denny Way from other locations, providing CSO reductions elsewhere in the system. For example, if the preferred alternative could accommodate up to 60 million gallons per day (mgd) in additional flows from the central trunk sewer, overflows at Third Avenue West might be reduced by as much as 80 percent. That kind of flexibility was of great importance during the Denny Way alternative selection process in 1994 and remains so today.

In November 1995, King County contracted with a consultant team headed by Brown and Caldwell to refine the initial preferred alternative in order to ensure there were no fatal flaws and to establish reliable cost estimates.

Following a request by the City of Seattle, the project team examined combining a CSO storage project with a City of Seattle proposal to realign Mercer Street in the south Lake Union area. It was hoped that constructing a large storage tank under Mercer Street would reduce the combined cost of constructing separate street and CSO projects. However, the conclusion of the combined Mercer Street realignment/CSO storage study was that significant cost savings are unlikely to result from combining the County's Denny Way CSO Control Project with the City's Mercer Street Realignment Project. Combining the two projects might actually increase the total cost. Furthermore, a combined project offers no significant advantages in terms of CSO control compared to the preferred Denny alternative. Combining the two projects might, however, have significant disadvantages in terms of construction, operation and maintenance. Following issuance of the Mercer realignment/CSO storage memorandum, the City of Seattle decided not to investigate this option further.

The project refinement work performed by the Brown and Caldwell team through March 1996 defined the project elements including system hydraulics; tunnel and pipeline alignments; and outfall, conveyance, and storage capacities. The team also prepared construction cost estimates and a construction schedule. Preliminary scheduling work indicated that construction of the first project element would be completed in year 2003.

Early in 1996, King County's RWSP team had reduced the number of alternative long-term wastewater management strategies to four. Three of the strategies called for on-site CSO treatment at a number of locations, including on-site treatment at Denny Way by year 2005. In March 1996, King County directed that additional work be performed to determine acceptable Ecology design criteria for CSO treatment and outfall discharges. The County wanted to explore constructing a CSO treatment facility in combination with or in lieu of a storage facility as a way of reducing overall project costs,

since there was essentially no time between the storage-only phase and on-site treatment. The project work between April and July 1996 focused on conceptual development of a CSO treatment facility. The treatment work included:

1. Preparation of estimates of the overall influent CSO volumes and solids loadings at the Denny Way regulator station and West Point Treatment Plant.

2. Research into and evaluation of treatment technologies presently being used by other wastewater utilities to reduce CSO discharges or to minimize water quality impacts of such discharges.

3. Analyzing alternatives for on-site treatment instead of a storage project followed by a treatment project later. The alternative analysis evaluated several CSO treatment processes, compared estimated costs, and made predictions about the effectiveness of each alternative at reducing suspended solids.

The team's treatment work was hampered by lack of data that would reliably characterize the CSO influent at Denny Way. Data concerning total suspended solids in CSO influent was limited, and very little data concerning settleable solids existed. In addition, the team had to develop a strategy to comply with Ecology's treatment regulations, which were written for continuous discharge rather than intermittent discharge plants.

Following completion of the treatment evaluation, the County modified its preferred project by deleting the CSO storage tank and reducing the tunnel diameter to 14 feet 8 inches; thereby reducing system storage capacity to approximately 7 MG. While storage capacity was reduced from the original project, submerged baffles for floatables control were added. Disinfection and dechlorination were also added to the original project configuration. The preferred County CSO control facility would reduce discharge volumes to Elliott Bay to about 290 MG per year. Untreated discharges would occur once a year for only two to three hours. About 280 MG per year of combined wastewater that had previously overflowed at the Denny Way regulator station or into Lake Union would be stored and conveyed to West Point, where that wastewater would receive treatment, disinfection, and be discharged. In addition to reducing CSO volumes (by diverting most of the CSO flow that would otherwise be discharged at Denny Way and Lake Union to West Point for treatment), the project would meet Ecology's 50 percent total suspended solids-removal criterion on an annual basis. The new King County CSO control facilities would meet Washington's Class A marine water quality standards for fecal coliform and residual chlorine as well.

1.3. Report Organization

This facilities plan report has been prepared in 12 chapters. The content of each chapter is as follows:

Chapter 1. Introduction

Chapter 1 discusses the history and context of the Denny Way/Lake Union CSO Control Project and describes the organization of this Facilities Plan report.

Chapter 2. Project Overview

The joint City of Seattle/King County project has been broken up into phases. Chapter 2 describes in greater detail the objectives of each of the phases and identifies the City and County responsibilities for completion of each project phase.

Chapter 3. Project Background Information

Chapter 3 describes in detail the Denny basin and the wastewater conveyance and treatment system that presently serves the basin.

Chapter 4. Future Conditions

Typically, a major wastewater system expansion will be intended to serve a population and an area over a longer term period. Chapter 4 examines population and land use trends within the Denny basin and identifies the long-term CSO flows and waste loads that will constitute system demand.

Chapter 5. CSO Control Regulatory Requirements

Chapter 5 examines the regulatory context within which the new CSO control system would have to operate.

Chapter 6. Evaluation of Principal Alternatives

This chapter examines CSO control and CSO discharge approaches and describes six control alternatives.

Chapter 7. Environmental Assessment of Principal Alternatives

Chapter 7 describes how each of the CSO control and discharge alternatives would impact the environment within the Denny basin.

Chapter 8. Preferred CSO Control Alternative Selection

This chapter describes the method used to select a preferred CSO control alternative for the Denny basin and identifies the alternative selected.

Chapter 9. Preferred Alternative Refinement

Chapter 9 describes various refinements and improvements made to the preferred alternative in order to improve performance and/or reduce costs.

Chapter 10. Final Project Configuration

Chapter 10 describes in detail each component of the modified preferred CSO control alternative. The chapter also describes how the system would function to provide CSO control and examines anticipated system performance.

Chapter 11. Public Participation

Chapter 11 describes the opportunities interested persons and agencies have had to participate in the alternative selection process for the Denny Way/Lake Union CSO Control Project.

Chapter 12. Implementation Plan

This final chapter of this facilities plan draft includes cost estimates and a project schedule for implementation of the modified preferred alternative.